

AMENDMENTS TO THE SPECIFICATION

IN THE TITLE OF THE INVENTION:

Replace the title of the invention with a new title:

-- IMAGE DISPLAY APPARATUS USING CURRENT-CONTROLLED LIGHT
EMITTING ELEMENT --.

IN THE SPECIFICATION:

Replace the paragraph beginning at page 1, line 6 with:

The present invention relates to an image display apparatus using a ~~current~~ current-controlled light emitting element, and more particularly to an active matrix image display apparatus ~~with brightness uniformly displayed on a display unit which~~ controls brightness uniformly across its display unit.

Replace the paragraph beginning at page 5, line 9 with:

An image display apparatus according to the present invention includes a ~~current~~ current-controlled light emitting element that emits light with a brightness corresponding to a current flowing in the ~~current~~ current-controlled light emitting element; a current source that supplies the current to the ~~current~~ current-controlled light emitting element; a driver element that includes at least first and second terminals and controls the current flowing into the ~~current~~ current-controlled light emitting element from the current source based on a potential difference applied between the terminals; a data line that supplies a potential to the first terminal; a conductive member that is electrically connected to the second terminal; and a threshold voltage obtaining unit that obtains a threshold

voltage of the driver element based on the potential of the conductive member corresponding to an amount of charges supplied from the current source to the second terminal.

Replace the paragraph beginning at page 6, line 9 with:

Figs. 3A, 3B, and ~~2C~~ 3C are diagrams for explaining operations of the image display apparatus according to the first embodiment.

Replace the paragraph beginning at page 7, line 19 with:

Fig. 1 is a schematic diagram of the entire configuration of the image display apparatus according to the first embodiment. As shown in Fig. 1, the image display apparatus according to the first embodiment includes an organic EL panel 1 with a large number of pixel circuits 2 that are arranged in a matrix, a Y driver 3 connected to the organic EL panel 1 through a scan line 5 and a grounding conductor (conductive member) 6, and an X driver 4 connected thereto through a data line 7. The grounding conductor 6 functions as one example of a conductive member in a scope of the claims, and is electrically connected to the driver element, explained later. The Y driver 3 has a configuration capable of outputting a predetermined electrical signal to the outside, and the electrical signal output is input to a controller (threshold voltage obtaining unit) 8 and stored in a storage unit 9 as numerical data. The controller 8 performs general controls for the components and functions as one example of a threshold voltage obtaining unit in the scope of the claims. Furthermore, the image display apparatus includes an adder 11 that adds the electrical signal output from the controller 8 and an electrical signal corresponding to a display image output from a video signal supply unit 10, and the electrical signal as the result of addition is supplied to the pixel circuits 2 through

the X driver 4. The image display apparatus further includes a current source 12 that supplies a current to a ~~current~~ current-controlled light emitting element included in the pixel circuit 2.

Replace the paragraph beginning at page 19, line 11 with:

There is still another advantage acquired by using the grounding conductor 6. In the first embodiment, the threshold voltage is obtained by using charges accumulated ~~on-floating~~ on the grounding conductor in a floating state, but in such a mode, a predetermined time is required for accumulation of charges ~~on floating~~ on the grounding conductor in a floating state.

However, the grounding conductor 6 exists in each row formed by many pixel circuits 2, and is arranged by the number of lines equal to the number of rows of the pixel circuits 2 that are arranged in a matrix. The individual grounding conductors 6 are simultaneously made to change to a floating state, and the charge for obtaining the threshold voltage can be accumulated simultaneously on the respective grounding conductors 6. The pixel circuits that belong to the same column are electrically connected to the same data line 7. Therefore, the driver elements belonging to the pixel circuits that are arranged in the same column can be simultaneously turned on by the potential supplied from the single data line 7, which allows the threshold voltages of the pixel circuits that belong to the same column to be obtained at a time.

Replace the paragraph beginning at page 23, line 4 with:

As shown in Fig. 6A, a connection destination of the grounding conductor 6 is switched to the controller 8 by the switch 20 to cause the potential of the scan line 5 to rise, and the thin film transistor 14 as the switching element is made to

be on-state. The gate electrode of the thin film transistor 15 is provided with a potential V_g supplied from the data line 7 to become on-state, which allows a current to pass through the organic EL element 13 and the channel layer of the thin film transistor 15. The state of the grounding conductor 6 is changed to a floating state caused by such a current, and charges are accumulated in the grounding conductor 6. A source electrode potential V_s of the thin film transistor connected to the grounding conductor 6 becomes $V_{com}(t_1)$ at the time $t=t_1$. The source electrode potential V_s in the second embodiment is first measured at $t=t_1$ to obtain $V_s = V_{com}(\underline{t_1})$.

Replace the paragraph beginning at page 26, line 14 with:

Furthermore, the image display apparatus according to the second embodiment can more accurately compensate for the electrical characteristic of the thin film transistor 15 that varies caused by the long-term use, by obtaining the coefficient β in the computing unit 27. The long-term use of the thin film transistor 15 causes not only the threshold voltage but also the slope of the linear area to change. In the slope of the linear area, the value of a current passing through the channel layer changes according to a change in the gate-source voltage. Therefore, in order to maintain the value of the current passing through the channel layer at a uniform level, it is required to determine a potential to be supplied from the data line 7 in consideration of such a change of the slope. The change of the slope due to the long-term use is proportional to a difference value between an initial value β_0 of a coefficient β and the coefficient β , and more accurately, a change amount Δa of the slope of the linear area is given by the following equation.

$$\Delta a = (\beta - \beta_0) / 2\beta_0 \quad \dots (3)$$

Therefore, in order to compensate for variation in the coefficient β in the thin film transistor 15 in which the characteristic varies, the potential of $(-\Delta\alpha \times V_g)$ needs to be added to the value of the potential V_g supplied from the data line 7. In other words, if the variation in the threshold voltage and the variation in the coefficient β are considered, the potential V_g to be actually supplied from the data line 7 to the gate electrode of the thin film transistor 15 is required to satisfy the following relational equation.

$$V_g = V_{th} + V_D - \{(\beta - \beta_0) / 2\beta_0\} \times V_g - V_D \quad \dots (4)$$

~~By solving the equation (4) to obtain V_g ,~~

$$V_g = (V_{th} + V_D) \times \{2\beta_0 / (\beta_0 + \beta)\} \quad \dots (5)$$

In the image display apparatus according to the second embodiment, the adder 11 obtains V_g according to the equation ~~(5)~~ (4) based on V_{th} and the coefficient β obtained in the computing unit 27, and based on V_D supplied from the video signal supply unit 10, and the electrical signal corresponding to V_g is supplied to the X driver 4.

Replace the paragraph beginning at page 28, line 12 with:

In the image display apparatus according to the second embodiment, the source electrode potential is detected before the thin film transistor 15 becomes off-state, which allows the threshold voltage to be obtained within a shorter period of time. That is, about one second is generally required between turning on once the thin film transistor 15 and turning it off. On the other hand, in the second embodiment, times t_1 and t_2 are within about 0.2 second as shown in Fig. 7. Actually, a source electrode potential can be detected a plurality of times within a shorter period of time than that of the example of Fig. 7. It is therefore possible to detect a source electrode potential the

required number of times within, for example, 0.01 second. Consequently, the required time becomes about 1/100 as compared with the case where the source electrode potential is detected after the thin film transistor 15 becomes off-state, which makes it possible to obtain a threshold voltage within an extremely short period of time. For example, even if the image display apparatus according to the second embodiment is ~~SXGA~~ a super extended graphics array (SXGA) type, the time required to obtain the threshold voltages of the driver elements that belong to all the pixel circuits is 15 seconds or less.

Replace the paragraph beginning at page 29, line 22 with:

Fig. 8 is a diagram of the entire configuration of the image display apparatus according to the third embodiment. As shown in Fig. 8, the image display apparatus according to the third embodiment includes the organic EL panel 1 with the pixel circuits 2 that are arranged in a matrix, the Y driver 3 connected to the organic EL panel 1 through the scan line 5 and the grounding conductor 6, and the X driver 4 connected thereto through the data line 7. The image display apparatus according to the third embodiment also includes the controller 8 that can input an electrical signal from the Y driver 3, a database 28 which a threshold voltage and a value of coefficient β can be referred to based on a value of the electrical signal input to the controller 8, and the storage unit 9 that stores the threshold voltage and the value of the coefficient β obtained by referring to the database 28. Furthermore, the image display apparatus includes the video signal supply unit 10 that outputs an electrical signal corresponding to a display image, and the adder 11 that adds ~~the electrical signal output from the video signal supply unit 10~~ the

electrical signal output from the video signal supply unit 10 and the electrical signal output from the controller 8 to supply the result of addition to the X driver 4. It is noted that in the third embodiment, components assigned with the same names and reference signs as those in the first embodiment and the second embodiment have the equivalent configurations and functions to those in the first embodiment unless otherwise specified below, and therefore, explanations thereof are omitted.

Replace the paragraph beginning at page 31, line 6 with:

Various modes of data structure of the database 28 can be considered. One of data structures is a structure in which a threshold voltage and a coefficient β are recorded with respect to a source electrode potential when a predetermined time has elapsed since measurement is started. If the shape of a channel layer of the thin film transistor 15 and a crystalline structure of silicon that forms the channel layer are known, the tendency of a variation pattern of the threshold voltage and the coefficient β is somewhat apparent empirically. Therefore, the threshold voltage and the coefficient β can be obtained with a predetermined level of accuracy even if the source electrode potential is not measured a plurality of times. They are measured a plurality of times, and the database 28 may be referred to based on the result of measurement. The adder 11 performs calculation based on the equation ~~(5)~~ (4) by using the threshold voltage and the coefficient β obtained to output the result of calculation to the X driver 4, which allows a supply of the potential V_g in which variations in the characteristic of the thin film transistor 15 are compensated for.

Replace the paragraph beginning at page 33, line 15 with:

The organic EL element is used as the ~~current~~ current-controlled light emitting element in the first to third embodiments, but, for example, an inorganic EL element or a light emitting diode may be used as the ~~current~~ current-controlled light emitting element. More specifically, any light emitting element in which brightness changes according to a value of inflow current may be used for the image display apparatus of the present invention. As for the interconnect structure used to measure a source electrode potential of the driver element, the grounding conductor 6 is not used but another interconnect structure may be provided.

Replace the paragraph beginning at page 33, line 24 with:

Furthermore, the driver element of the present invention is based on the thin film transistor of which channel layer is formed of amorphous silicon. However, the present invention may be applied to the case where the driver element is formed with the thin film transistor of which channel layer is formed of polysilicon. When the channel layer is formed of polysilicon, variations in characteristics of the thin film transistor may occur in each pixel due to variations in particle size or the like. In order to compensate for the variations in the characteristics of the thin film transistor, application of the present invention allows the brightness of the ~~current~~ current-controlled light emitting element such as the organic EL element to be uniform.